Challenging Chamber

JSC volunteers pave way for self-sufficient future space outposts

By James Hartsfield

Four JSC volunteers have spent more than three weeks, 24 hours a day, sealed in a converted vacuum chamber in Bldg. 7, continually recycling a week's worth of air and water to test technology that may one day become a cornerstone of human survival beyond Earth orbit.

The test is the second phase of the Advanced Life Support Program's Early Human Testing Initiative. Mechanical and chemical means are being used to recycle all air and water, including urine, for the four people in the chamber. The current test is planned to last 30 days. It follows a two-week, one-person test conducted in August 1995 that used a crop of wheat plants to recycle the test subject's breathing air.

"This test expands on last year's investigation extensively, studying totally different technologies—physicochemical rather than biological—on a scale more than four times greater," said Don Henninger, chief scientist for regenerative life support systems. "Regenerable life support is a critical enabling technology for the future of humans in space. Without it, trips to Mars or to the Moon to establish bases are simply impossible. You just cannot carry all of the supplies needed for such voyages without recycling."

Test Crew Leader Doug Ming, 40, a space scientist; John Lewis, 29, a lead engineer for the project; Pat O'Rear, 29, a lead electrical engineer on the project; and Katy Hurlbert, 31, an aerospace engineer and spacecraft thermal systems expert, have been living inside the three-story, 20-foot diameter chamber since June 12 and plan to remain there until July 12.

The chamber has no windows to speak of, although on the third floor each person has a closet-sized individual bedroom that includes a small desk and computer, complete with an attachment to cable television. The entire first floor of the chamber is the combination living room, dining room, kitchen, laundry room, bathroom and water recycling equipment. The second floor holds much of the equipment that is continuously recycling the chamber air.

But life inside of the "Can," as the chamber has become somewhat affectionately called by those involved, is not bad, crew members said recently.

"I have been really impressed with it so far," Lewis said. "And I have been really pleased with the performance of the systems. Based on what we knew coming in, I thought we were going to have more problems than we've actually had. I was expecting more of a noticeable odor in this chamber, but it is such a large chamber, you don't really notice any. As for the water, it tastes good and we turn it into Kool-Aid as well and drink it that way. It tastes fine."

"I guess one of the reasons we haven't hit the boredom level is because we have yet to have a typical day in here," O'Rear added. "Every day we have had so far has been completely different. The time has actually flown by. It's kind of hard to keep track of the days, because the time has gone by so quickly. At this point, I am actually kind of disappointed that it is only going to be 30 days. I kind of wish there were going to be a few more."

The crew members' motivation for taking part in the test runs along a common theme—paving the way toward the future in space. "I truly believe that this is a stepping stone to a first lunar outpost," Ming said. "I think everything we develop from now on in this program will be the root of it all."

Hurlbert echoed those sentiments, and said she finds motivation daily to remind her why she is taking part. "I asked to have a picture of the Mars surface in front of the treadmill, and now, when I am running every morning, I find myself daydreaming that years from now we may be beginning to work on an outpost there," she explained. "Those dreams really motivate me to run harder, run faster and try to get us there as soon as possible."

For the two engineers in the crew, motivation comes from different sources as well, Lewis added. "When Pat and I are working on the systems to maintain or repair them, it really justifies our being here, and I'm glad I'm the one who gets to be in here," he said. "Since I was deeply involved in the design of these systems, volunteering for this test was sort of like putting my money where my mouth is."

The four crew members and four alternate crew members were chosen from a field of more than 40 people who volunteered from among those who work with life support systems development at JSC.

"I was surprised by the response," Henninger said. "It is a lot of work, and all of those who volunteered knew just what it entailed."

A total of about 60 people work with the Advanced Life Support Program at JSC, and the program is supported by researchers at Kennedy Space Center, Ames Research Center and NASA's Jet Propulsion Laboratory, as well as university and industrial researchers. All of those involved share a deep commitment to the work, Henninger said.

Since an average astronaut would use about 22,000 pounds of water and 730 pounds of oxygen in a year, recycling these and other consumables is a necessity for long stays in space. In the Phase 2 test, air is recycled by removing and concentrating the carbon dioxide from the chamber. Hydrogen is combined with the carbon dioxide to create water, methane and other trace gases. The methane and other gases are disposed of, and electrolysis is used to split the water into oxygen and hydrogen. The oxygen is put back into the chamber and the hydrogen is used to recycle carbon dioxide.

Shower water, other personal hygiene water, and laundry water are recycled using an ultra-filtration/reverse osmosis system. Urine is processed separately by distillation. The resulting water is tested to meet far more stringent standards than are in place for municipal tap water and then is reused.

Without recycling, the air and water in the test would have lasted less than a week. Although the physicochemical systems used in this test are working well, the actual life support systems used in space in the future will likely consist of both plants and physicochemical processes, Henninger said. Plants and physicochemical systems such as are being tested now will both be a part of a Phase III 90-day, four-person test targeted for 1997. Beyond the Early Human Testing Initiative, future tests in a new Human Rated Test Facility will simulate a true spacecraft or base as closely as possible, with not only air, water and solid waste recycled, but also a self-sufficient food supply from plants. All machinery would be housed inside of the HRTF modules as well, just as would be the case in space.

"The goal of this testing is to identify areas where research is needed, look at the performance of a combination of hardware and to prove this technology is compatible with humans," he explained.

"The people working on this program feel like what they are doing will become a part of history. We will leave Earth orbit again one day, and we will have outposts on the Moon and Mars," Henninger said. "Every one of them will tell you that it is going to happen—the only question is when. And everyone is excited that they will have been a part of it when it does." ❑

From left to right, top to bottom; 1) Test crew members for the 30-day recyclable life support test now under way in Bldg. 7 include, from left, Katy Hurlbert, Doug Ming, John Lewis and Pat O'Rear. 2) From left David Staat, Stephanie Ayers, Nigel Packmham, Russ Bachtel and Burt Laws monitor the test chamber to ensure the volunteers safety. 3) Hurlbert and Ming take an air sample inside the chamber.4) Ming sorts through sample bottles inside the chamber. Water and air samples are taken several times daily as part of the test procedure, as well as swabs from the nose and throat of the test crew members. 5) Hurlbert and Ming prepare a meal inside the Bldg. 7 test chamber.